

Analysis of Body Mass Index and Cardiovascular Endurance (VO₂ Max) among Futsal Teams in Manggelewa District in 2025

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Abstract

Objectives: This study aimed to analyze the body mass index (BMI) and cardiovascular endurance level (VO₂ Max) of futsal players in Manggelewa District and to examine whether there was a relationship between BMI and VO₂ Max. This study also investigated whether VO₂ Max differed significantly across BMI categories.

Materials and Methods: This study used a quantitative descriptive and correlational design. The participants were 60 male futsal players from three futsal teams in Manggelewa District, namely Sima FC, Venom FC, and Fortuna 19 Manggelewa. The sampling technique used was purposive sampling. BMI was measured using body weight and height, while cardiovascular endurance was measured using the Multistage Fitness Test or bleep test. Data were analyzed using descriptive statistics, the Kolmogorov–Smirnov normality test, Pearson correlation, and one-way ANOVA.

Results: The BMI results showed that most players were in the ideal body weight category, with 45 players (75%). Meanwhile, 4 players (6.67%) were classified as severely underweight, 8 players (13.33%) as mildly underweight, and 3 players (5%) as overweight. The VO₂ Max results showed that 33 players (55%) were in the very low category, 11 players (18.33%) in the low category, and 16 players (26.67%) in the moderate category. The Pearson correlation test showed no significant relationship between BMI and VO₂ Max ($p = 0.470$). The one-way ANOVA also showed no significant difference in VO₂ Max based on BMI categories ($F = 2.28$; $p = 0.111$).

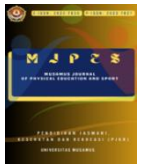
Conclusions: Most futsal players in Manggelewa District had a normal BMI; however, their cardiovascular endurance was generally very low. There was no significant relationship between BMI and VO₂ Max, and no significant difference in VO₂ Max was found across BMI categories.

Keywords: body mass index, cardiovascular endurance, VO₂ Max, futsal, physical fitness

Introduction

Futsal is a fast, dynamic, and high-intensity sport that requires players to move continuously, change direction quickly, and perform technical skills under physical pressure (Caetano et al., 2015; Pizarro, D., , Travassos, B., & Moreno, A., 2020). In a futsal match, players are required to perform various actions such as passing, controlling, dribbling, and shooting within a limited playing area and short playing time. Therefore, good physical fitness is essential to support technical and tactical performance during competition (Andika et al., 2020).

Physical fitness is an important factor that supports athletic performance, including in futsal.



Players with good physical condition are more capable of maintaining movement intensity, executing technical skills effectively, and following tactical instructions throughout the match (Micheo et al., 2012; Nawawiwetu & Lutfiya, 2020a; Siedentop, 2012). In contrast, poor physical condition may reduce performance, increase fatigue, and limit players' ability to contribute optimally during the game (Marquez et al., 2020; Suto et al., 2021).

One important component of physical fitness is cardiovascular endurance, commonly measured using VO_2 Max. VO_2 Max reflects the body's capacity to use oxygen during prolonged physical activity. In futsal, good cardiovascular endurance allows players to maintain high-intensity movements, recover quickly between actions, and sustain performance until the end of the match.

In addition to cardiovascular endurance, body composition is also an important factor in sports performance. Body Mass Index (BMI) is commonly used as a simple indicator to classify nutritional status based on body weight and height. Although BMI does not directly distinguish between fat mass and muscle mass, it can provide an initial overview of body composition that may influence movement efficiency, energy expenditure, and injury risk.

Initial observations in Manggelewa District showed that several futsal teams actively participated in local tournaments. However, many players appeared to have limited physical endurance during competition, especially in maintaining intensity and technical performance. This condition indicates the importance of assessing both BMI and cardiovascular endurance among futsal players.

Therefore, this study aimed to analyze BMI and cardiovascular endurance levels among futsal players in Manggelewa District. This study also examined the relationship between BMI and VO_2 Max and investigated whether VO_2 Max differed significantly based on BMI categories.

Materials and Methods

Study Design

This study used a quantitative descriptive and correlational research design (Sugiyono, 2012). The descriptive approach was used to describe BMI and VO_2 Max levels, while the correlational approach was used to examine the relationship between BMI and cardiovascular endurance.

Participants

The participants were 60 male futsal players from three futsal teams in Manggelewa District: Sima FC, Venom FC, and Fortuna 19 Manggelewa. Each team consisted of 20 players. The sampling technique used was purposive sampling, based on the players' active participation in futsal activities and tournaments.



Instruments and Measurements

BMI was calculated using body weight in kilograms divided by height in meters squared. The BMI results were classified based on the Indonesian Ministry of Health BMI categories.

Cardiovascular endurance was measured using the Multistage Fitness Test, also known as the bleep test. The VO₂ Max results were classified based on age-related fitness norms for male participants.

Data Analysis

Data were analyzed using descriptive statistics, including frequency, percentage, minimum score, maximum score, mean, and standard deviation. The Kolmogorov–Smirnov test was used to examine data normality. Pearson correlation was used to determine the relationship between BMI and VO₂ Max. One-way ANOVA was used to examine differences in VO₂ Max based on BMI categories. The analysis was conducted using SPSS version 26.

Results

Descriptive Statistics of BMI and VO₂ Max

The descriptive statistics showed that 60 futsal players participated in this study. The BMI scores ranged from 14.8 to 27.4, while the VO₂ Max scores ranged from 20.7 to 42.4.

Table 1. Descriptive Statistics of BMI and VO₂ Max

Variable	Total Score	Minimum	Maximum	Mean	Standard Deviation
BMI 60	1257.1	14.8	27.4	20.95	2.51
VO₂ Max 60	1937.1	20.7	42.4	32.28	5.02

BMI Classification

The results showed that most players had an ideal body weight. A total of 45 players (75%) were classified as having ideal body weight.

Table 2. BMI Classification of Futsal Players

BMI Category	Frequency	Percentage
Severely underweight	4	6.67%
Mildly underweight	8	13.33%
Ideal body weight	45	75.00%
Mildly overweight	0	0.00%
Overweight	3	5.00%
Total	60	100.00%

VO₂ Max Classification

The VO₂ Max results showed that most players had very low cardiovascular endurance.

Table 3. VO₂ Max Classification

Category	Frequency	Percentage
Very low	33	55.00%
Low	11	18.33%
Moderate	16	26.67%
Good	0	0.00%
Very good	0	0.00%
Excellent	0	0.00%
Total	60	100.00%

Normality Test

The Kolmogorov–Smirnov test showed that both BMI and VO₂ Max data were normally distributed.

Table 4. Kolmogorov–Smirnov Normality Test

Variable		Statistic	Sig.	Description
BMI	60	0.106	0.091	Normal
VO₂ Max	60	0.086	0.200	Normal

Relationship between BMI and VO₂ Max

The Pearson correlation test showed no significant relationship between BMI and VO₂ Max. The significance value was 0.470, which was greater than 0.05.

Table 5. Pearson Correlation between BMI and VO₂ Max

Variables	Person Correlation	Sig.
BMI and VO₂ Max	-0.095	0.470

Differences in VO₂ Max Based on BMI Categories

The one-way ANOVA showed no significant difference in VO₂ Max based on BMI categories.

Table 6. Mean VO₂ Max by BMI Category

BMI Category		Mean VO ₂ Max	Standard Deviation
Overweight		26.37	4.56
Underweight	12	32.33	4.37
Normal	45	32.89	5.32

**Table 7.** One-Way ANOVA Results

Source	Sum of Squares	df	Mean Square	p-value
Between groups	108.54	2	54.27	2.28 0.111
Within groups	1230.87	57	21.59	
Total	1339.41	59		

The ANOVA result indicated that there was no significant difference in VO₂ Max among BMI categories ($F = 2.28$; $p = 0.111$).

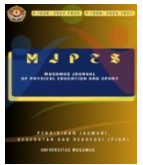
Discussion

The results of this study showed that most futsal players in Manggelewa District had a normal BMI. A total of 75% of the players were classified as having ideal body weight. This finding suggests that most players had a generally acceptable body composition based on BMI classification. BMI is commonly used as a simple indicator to assess body weight status relative to height. According to Azzubaidi et al. (2023), (Blongkod, 2022; Nawawiwetu & Lutfiya, 2020b) BMI is often used to classify body weight status and identify the risk of overweight and obesity in adults. Similarly, Pranata (2017) (Hermassi et al., 2021; Lin & Wu, 2013) stated that BMI can be used as a practical method to describe an athlete's nutritional status.

Although most players had normal BMI, the VO₂ Max results showed that their cardiovascular endurance was generally low. More than half of the players, or 55%, were classified in the very low category, while 18.33% were in the low category and only 26.67% were in the moderate category. This indicates that having normal BMI does not automatically reflect good cardiovascular endurance.

This finding is consistent with (Allen & Ross, 2013; Donnelly, 2017; Moghaddaszadeh A & Belcastro AN, 2021), who stated that good physical fitness enables individuals to perform more intense physical activities, and VO₂ Max is one of the important indicators of physical fitness. Players with low VO₂ Max may experience early fatigue during high-intensity sports such as futsal. In futsal, players need to perform repeated sprints, rapid changes of direction, defensive pressure, and attacking transitions. Therefore, low cardiovascular endurance may reduce the ability to maintain performance throughout the match.

The low VO₂ Max level found in this study may be influenced by several factors, such as insufficient structured physical training, limited recovery time before testing, and inconsistent training participation. This explanation is supported by Juniardi, Atiq, and Purnomo, who reported that VO₂ Max



can be influenced by training habits, physical condition maintenance, coaching programs, and nutritional intake. Similarly, (Kuswoyo et al., 2020; Lee et al., 2017; Yan et al., 2023) emphasized that football and futsal players require adequate VO_2 Max to support physical activity and oxygen supply during training and competition.

The Pearson correlation test showed no significant relationship between BMI and VO_2 Max. This means that BMI alone did not determine the cardiovascular endurance level of futsal players in this study. Although BMI can provide information about body weight status, it does not directly measure aerobic capacity, training adaptation, muscle mass, or cardiorespiratory efficiency. Therefore, a player with normal BMI may still have low VO_2 Max if he does not regularly perform endurance-based training.

The one-way ANOVA also showed no significant difference in VO_2 Max based on BMI categories. This finding indicates that differences in BMI category, such as underweight, normal, and overweight, did not significantly influence VO_2 Max among the futsal players. This result supports the argument that cardiovascular endurance is more strongly influenced by training quality, training frequency, aerobic conditioning, and lifestyle habits than by BMI category alone.

Overall, the findings show that futsal teams in Manggelewa District need greater attention to cardiovascular endurance training. Coaches should not only consider body weight status but also design structured aerobic and interval training programs to improve VO_2 Max. Improving cardiovascular endurance is essential because futsal requires repeated high-intensity actions and fast recovery during match play.

Conclusions

This study concluded that most futsal players in Manggelewa District had a normal BMI, with 75% of players classified as having ideal body weight. However, their cardiovascular endurance was generally very low, with 55% of players classified in the very low VO_2 Max category.

The Pearson correlation test showed no significant relationship between BMI and VO_2 Max ($p = 0.470$). The one-way ANOVA also showed no significant difference in VO_2 Max based on BMI categories ($F = 2.28$; $p = 0.111$). Therefore, BMI category did not significantly determine cardiovascular endurance among futsal players in Manggelewa District.



References

- Allen, R., & Ross, C. M. (2013). An Assessment of Proximity of Fitness Facilities and Equipment and Actual Perceived Usage by Undergraduate University Students: A Pilot Study. *Recreational Sports Journal*, 37(2), 123–135. <https://doi.org/10.1123/rsj.37.2.123>
- Andika, A., Saputra, Y. M., & Hamidi, A. (2020). Hubungan Tingkat Kecerdasaan Intelektual (IQ) dan Kecerdasaan Emosional (EQ) dengan Penampilan Bermain Futsal. *MEDIKORA*, 19(1), 1–7. <https://doi.org/10.21831/medikora.v19i1.30025>
- Blongkod, F. R. (2022). *Analysis of Dieting, Intake and Nutritional Status of Bina Mandiri Gorontalo University Students During Pandemic*.
- Caetano, F. G., De Oliveira, M. J., Marche, A. L., Nakamura, F. Y., Cunha, S. A., & Moura, F. A. (2015). Characterization of the Sprint and Repeated-Sprint Sequences Performed by Professional Futsal Players, According to Playing Position, During Official Matches. *Journal of Applied Biomechanics*, 31(6), 423–429. <https://doi.org/10.1123/jab.2014-0159>
- Donnelly, J. A. (2017). The Relationship Between Physical Fitness and School Performance. *Journal of Social, Behavioral, and Health Sciences*, 11(1). <https://doi.org/10.5590/JSBHS.2017.11.1.16>
- Hermassi, S., Van Den Tillaar, R., Bragazzi, N. L., & Schwesig, R. (2021). The Associations Between Physical Performance and Anthropometric Characteristics in Obese and Non-obese Schoolchild Handball Players. *Frontiers in Physiology*, 11, 580991. <https://doi.org/10.3389/fphys.2020.580991>
- Kuswoyo, D. D., Wasa, C., & Dongoran, M. F. (2020). Back-up training effects to the students' ability in heading the ball. *Edu Sportivo Indonesian Journal of Physical Education*, 1(1), Article 1. [https://doi.org/10.25299/es:ijope.2020.vol1\(1\).5190%0AHow](https://doi.org/10.25299/es:ijope.2020.vol1(1).5190%0AHow)
- Lee, E. C., Fragala, M. S., Kavouras, S. A., Queen, R. M., Pryor, J. L., & Casa, D. J. (2017). Biomarkers in Sports and Exercise: Tracking Health, Performance, and Recovery in Athletes. *Journal of Strength and Conditioning Research*, 31(10), 2920–2937. <https://doi.org/10.1519/JSC.0000000000002122>
- Lin, C.-C., & Wu, Y.-C. (2013). The Effects of Different Presentation Modes of Multimedia Annotations on Sentential Listening Comprehension. *International Conference on Computers in Education*. <https://doi.org/10.58459/icce/2013/1089>
- Marquez, D. X., Aguiñaga, S., Vásquez, P. M., Conroy, D. E., Erickson, K. I., Hillman, C., Stillman, C. M., Ballard, R. M., Sheppard, B. B., Petruzzello, S. J., King, A. C., & Powell, K. E. (2020). A systematic review of physical activity and quality of life and well-being. *Translational Behavioral Medicine*, 10(5), 1098–1109. <https://doi.org/10.1093/tbm/ibz198>
- Micheo, W., Baerga, L., & Miranda, G. (2012). Basic Principles Regarding Strength, Flexibility, and Stability Exercises. *PM&R*, 4(11), 805–811. <https://doi.org/10.1016/j.pmrj.2012.09.583>
- Moghaddaszadeh A & Belcastro AN. (2021). Guided Active Play Promotes Physical Activity and Improves Fundamental Motor Skills for School-Aged Children. *Journal of Sports Science and Medicine*, 86–93. <https://doi.org/10.52082/jssm.2021.86>
- Nawawiwetu, E. D., & Lutfiya, I. (2020a). Factors Associated With the Ability To Perform Physical Fitness Tests With Qcst. *Journal of Vocational Health Studies*, 3(3), Article 3. <https://doi.org/10.20473/jvhs.v3.i3.2020.97-102>
- Nawawiwetu, E. D., & Lutfiya, I. (2020b). Factors Associated With the Ability To Perform Physical



- Fitness Tests With Qcst. *Journal of Vocational Health Studies*, 3(3), 97.
<https://doi.org/10.20473/jvhs.v3.i3.2020.97-102>
- Pizarro, D., , Travassos, B., & Moreno, A., P., A. (2020). *Development of Defensive Actions in Small-Sided and Conditioned Games With Offensive Purposes in Futsal*—PubMed.
<https://pubmed.ncbi.nlm.nih.gov/33192934/>
- Siedentop, D. (with Internet Archive). (2012). *Introduction to physical education, fitness, and sport*. New York : McGraw-Hill. http://archive.org/details/introductiontoph0000sied_t1o1
- Sugiyono. (2012). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. CV. Alfabeta.
- Suto, M., Miyazaki, C., Yanagawa, Y., Takehara, K., Kato, T., Gai, R., Ota, E., & Mori, R. (2021). Overview of Evidence Concerning School-Based Interventions for Improving the Health of School-Aged Children and Adolescents. *Journal of School Health*, 91(6), 499–517.
<https://doi.org/10.1111/josh.13021>
- Yan, J., Jones, B., Smith, J. J., Morgan, P., & Eather, N. (2023). A Systematic Review Investigating the Effects of Implementing Game-Based Approaches in School-Based Physical Education Among Primary School Children. *Journal of Teaching in Physical Education*, 42(3), 573–586.
<https://doi.org/10.1123/jtpe.2021-0279>